

NAME P/N QTY	CRIT	FAILURE MODE & CAUSES	FAILURE EFFECT	RATIONALE FOR ACCEPTANCE
LOWER ARM RESTRAINT AND BLADDER ITEM 103 (1) LEFT (1) RIGHT	2/1R	103FM13 Loss of lower primary axial restraint webbing.	END ITEM: Loss of primary axial restraint.	A. Design - The lower arm assembly axial restraints are fabricated from 1/2" wide Spectra 1000 webbing. Size "F" and "FF" polyester thread conforming to V-T-285D type II, class I is used to fabricate the primary axial restraints with type 301 lock stitching conforming to FED-STD-751A. Seams are terminated by backtack and searing of thread ends. Worn thread is precluded by design as a function of the abrasion protection afforded to the arm restraint by the TMG.
0103-810151-02 0103-810151-03 (2)		Defective Material, worn thread or webbing.	GFE INTERFACE: Axial load will be transferred to secondary restraint. MISSION: None.	Axial restraint pulled to destruction during design verification testing exhibited an ultimate strength of 1455 lbs. At 4.4 psid (normal operating pressure) the S/AD limit load is 219 lbs, giving the restraints a safety factor of 6.6 for ultimate. At 5.5 psid (max. failure pressure) and at 8.8 psid (max BTA operating pressure), the restraints exhibit ultimate safety factors fo 7.1 and 9.2, respectively. The S/AD minimum safety factor for softgoods at 4.4 psid is 2.0 for ultimate. At both 5.5 psid and 8.8 psid the S/AD minimum ultimate safety factor for softgoods is 1.5.
			CREW/VEHICLE: None with loss of primary webbing. Loss of crewman with loss of secondary restraint webbing.	B. Test - Acceptance: The lower arm primary and secondary axial restraints are subjected to S/AD limit load of 219 pounds during fabrication of each lower arm restraint.
			TIME TO EFFECT /ACTIONS: Minutes.	PDA: The following test is conducted at Arm Assembly level in accordance with ILC Document 0111-710112: A proof-pressure test at 8.0 + 0.2 - 0.0 psig for a minimum of 5 minutes conducted with the TMG removed.
			TIME AVAILABLE: Days.	Certification: The lower arm axial restraints were successfully tested (manned) during SSA certification to duplicate 458 hours operational usage (Ref. ILC Report 0111-711330).
			TIME REQUIRED: Days.	The following usage, reflecting requirements of significance to the lower arm, was documented during certification:
		REDUNDANCY SCREENS: A-PASS B-N/A C-PASS	Primary Axial Restraint Requirement S/AD Actual ----- Shoulder Rotation 29348 60000 Elbow Flex/Ext 49660 102000 Don/Doff 98 400 Pressure Hours 458 916 Pressure Cycles 194 @ 4.3 psid 388 74 @ 5.3 psid 148 32 @ 6.6 psid 64	
				Secondary Axial Restraint Requirement S/AD Actual ----- Shoulder Rotation 14674 30000

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103FM13

Elbow Flex/Ext	24830	51000
Pressure Cycles	150	300

The lower arm axial restraints were successfully subjected to an ultimate pressure of 13.2 psid during SSA certification (Ref. ILC Report 0111-711330). This is 1.5 times maximum operating pressure based on 8.8 psid.

C. Inspection -

Components and material manufactured to ILC requirements at an approved supplier are documented from procurement through shipping by the supplier. ILC incoming receiving inspection verifies that the materials received are as identified in the procurement documents, that no damage has occurred during shipment and that supplier certifications have been received which provides traceability information.

The following MIP is performed during the arm assembly manufacturing process to assure that the failure causes are precluded from the fabricated item:

1. Verification of visual inspection of restraints for evidence of degradation following S/AD limit load pull test.

During PDA, the following inspection points are performed at the arm assembly level in accordance with ILC Document 0111-710112:

1. Inspection for fabric or material degradation.
2. Verification of no damage following primary/secondary loading at 219 pounds.
3. Visual inspection for damage following proof pressure test.

D. Failure History -

B-EMU-103-T004 (1/18/99) -

Primary axial restraint damaged at outboard edge of the restraint line caused by lifting/shifting motion of the axial restrained against the restraint bracket pin accompanied by exposure to NBL water. The failure has only occurred in gear exposed to a wet environment. No corrective action required. At NASA's request, subsequent Class IIIW hardware with this anomaly will be addressed on DR/MRB and evaluated. Pre-flight visual inspections per FEMU-R-001 exist to identify such anomalies on CLI hardware.

B-EMU-103-T006 (8/25/99) -

Tracked by B-EMU-103-T004

B-EMU-103-T006 (8/27/99) -

Tracked by RDR B-EMU-103-T004

B-EMU-103-T007 (4/8/00) - During pressurized testing of Class IIIW hardware for NBL NITROX testing support, left arm primary restraint broke near primary restraint bracket. High loads and relative motion of Primary Axial Restraint against bracket pin combined with negative influence of NBL caused failure. Combination of failure causing conditions exist only during NBL testing. Corrective Action not required for CL I and CL II hardware. Use of CL III hardware acceptable provided restrictions per ILC EM#00-0019 are followed.

E. Ground Turnaround -

None for every component which is within its limited life requirements.

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		103FM13		<p>Also, every 4 years or 229 hours of manned pressurized time the arm restraint and bladder assemblies are removed from the arm assembly and subjected to a complete visual inspection (interior and exterior surfaces) for material damage and degradation.</p> <p>F. Operational Use - Crew Response - PRE EVA: No response. Single failure is not likely to be detected. If problem detected tactually or audibly, trouble shoot. If no success, consider 3rd EMU if available. Otherwise terminate EVA prep. Lower arm assembly no go for EVA. EVA: No response. Single failure not detectable. Training - No training specifically covers this failure mode. Operational Considerations - Not applicable.</p>

EXTRAVEHICULAR MOBILITY UNIT
SYSTEMS SAFETY REVIEW PANEL REVIEW
FOR THE
I-103 ARM ASSEMBLY
CRITICAL ITEM LIST (CIL)

EMU CONTRACT NO. NAS 9-97150

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